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Changes in permittivity and density of molecular liquids under high pressure

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Abstract

We collected and analyzed the density and permittivity of 57 nonpolar and dipolar molecular liquids at different temperatures (143 sets) and pressures (555 sets). No equation was found that could accurately predict the change to polar liquid permittivity by the change of its density in the range of the pressures and temperatures tested. Consequently, the influence of high hydrostatic pressure and temperature on liquid permittivity may be a more complicated process compared to density changes. The pressure and temperature coefficients of permittivity can be drastically larger than the pressure and temperature coefficients of density, indicating that pressure and particularly temperature significantly affect the structure of molecular liquids. These changes have less influence on the density change but can strongly affect the permittivity change. The clear relationship between the tangent and secant moduli of the permittivity curvatures under pressure for various molecular liquids at different temperatures was obtained, from which one can calculate the Tait equation coefficients from the experimental values of the pressure influence on the permittivity at ambient pressure.

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